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Minimum Competencies
Series (T) II

MINIMUM VOCATIONAL COMPETENCIES BASED CURRICULUM

MECHANICAL TECHNOLOGY

VOCATIONALIZATION OF EDUCATION UNIT
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING
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I N T R O D U C T I O N

On the request of the Department of Education Gujarat State, the Vocationalization of Education Unit, NCERT organised a workshop at Vallabh Vidya Nagar, Anand from 16th April to 20th April 1983 for analysis of the curricula (New Scheme) to spell out and identify practical and skill components. The syllabus of Mechanical Engineering Technology has been systematically analysed with the help of a number of experts, experienced teachers and curriculum framers.

The following steps were followed in analysis of the course:-

- 1) Listing of job opportunities
- 2) Writing activities under each job
- 3) Analysing activities for the identification of cognitive, affective and psychomotor skills
- 4) Deriving the course objectives to determine curriculum areas.
- 5) Designing syllabus on the basis of above analysis
It is hoped that this course which has been analysed on the basis of job-analysis and actual duties performed by the workers either in industry on wage employment or carrying out their own business, will help in making the programme really job oriented.

Name of Vocation - Mechanical Technology

Job - opportunity

1. Self employment in workshop
2. Employment as a workshop charginan in
 - a. Turning shop
 - b. Fitting shop
 - c. Welding shop
3. Employment as a skilled worker in trades of
 - a. Turning
 - b. Fitting
 - c. Welding
4. May continue to have vertical mobility, in same Vocation.

Comprehensive Job Description/List of activity based on job opportunity.

1. To prepare a project report.
2. To establish the enterprise.
3. To estimate the cost and time requirement for a job.
4. To negotiate with customer effectively and procure the orders.
5. To review the progress of job.
6. To maintain good relations with personnels and fellow workers.
7. To procure tools and raw materials.
8. To maintain accounts.
9. To communicate effectively using regional language.
10. To read and understand blue-print.
11. To identify different grades of surface finish.
12. To determine proper speed, feed and depth of cut for the turning jobs.
13. To set the lathe machine as per the determined speed, feed, and depth of cut.
14. To perform turning operations on lathe machine. (Cylinder and taper turning)
15. To perform the thread cutting operations on lathe machine.
16. To inspect the finished job.
17. To identify the accessories provided with machine viz.
18. Grinding of the tool as per the required geometry.

19. To identify the specific functions of lathe machine using special attachments.
 - a) Drilling
 - b) Milling
 - c) Grinding
20. To use the fitting shop hand tools.
21. To perform scraping, cutting, and chipping operations.
22. To perform filing operations.
23. To perform measuring operations.
24. To perform drilling operations.
25. To perform inspection
26. To perform operation with taps and dies.
27. To prepare the edges.
28. To set the job on table.
29. To select proper welding technique. (Gas or Electric or Electric Resistance)
30. To adjust the gas pressures.
31. To select the proper nozzle.
32. To adjust the flame.
33. To do Gas welding operations.
34. To clean the weld.

- 35. To adjust the proper voltage and current for electric arc welding.
- 36. To select the proper electrode.
- 37. To perform the electric arc welding.
- 38. To inspect the weld.
- 39. To adjust the current and timer for electric resistance welding.

Job Versus Activity

| S.No. | Type of Job. | Class of Job | |
|-------|--------------------|--|-----------------------|
| | | Wage employment | Self employment |
| 1. | is an entrepreneur | | |
| | a) Turning shop | | 1 to 19 |
| | b) Fitting shop | | 1 to 11, 16, 20 to 26 |
| | c) Welding shop | | 1 to 10, 16, 27 to 39 |
| 2. | Skilled worker | | |
| | a) Turning | 6, 9 to 16, 17, 18 | |
| | b) Fitting | 6, 9, 10, 11, 16, 20 to 26 | |
| | c) Welding | 6, 9, 10, 16, 27, 28, 30 to 35 37, 39. | |
| 3. | Workshop Chargeman | | |
| | a) Turning | 3, 5, 9 to 19 | |
| | b) Fitting | 3, 5, 6, 9, 10, 11, 16, 20, 21, 23 to 26 | |
| | c) Welding | 3, 5, 6, 9, 10, 16, 28, 29, 31, 35, 36, 33, 39 | |

TASK ANALYSIS (Identification of Knowledge, Skills and Personality traits)

| Job Description/ Activity | Knowledge | Skill | Personality Traits. |
|---|---|--|---|
| 1. To prepare project Report | Preparation of Project Report considering market survey, feasibility financial resources, economic viability, taxation and levy of duties. | Ability to prepare project and feasibility reports, to handle finances | Interest and enthusiasm leadership confidence perseverance courteous and cheerful Good speech habits, Punctuality |
| 2. To Establish enterprise. | Site selection, registration procedures procurement of tools and equipment, knowledge about sales (tenders and quotations). Book-keeping and account/publicity. Salesmanship, Potential suppliers and products sales, comparable quality and costs. | | - d. - & Tactfulness Initiative Promptness |
| 3. To estimate the cost and time requirement for a job. | Making Estimates by knowing the Prevailing market rates of various raw materials, and tools, knowledge regarding the working of machines and the calculations for time for getting the finished good. | Ability to perform the operations | Hard work and Sincerity |

| 1 | 2 | 3 | 4 |
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| 4. To negotiate with customers effectively and procure orders | Knowledge of comparison of quality and Price, and importance of delivery schedules | To do the market research and effective salesmanship | Punctuality, Courtesy, Judgement, Acceptance of Responsibility. |
| 5. To review the progress of job | <ol style="list-style-type: none"> Working of the various machines Job loading Estimation of time schedule. | Effective loading of men & machine | Acceptance of Responsibility Courtesy, Cheerfulness Good speech habits, Enthusiasm, Personal Grooming, Judgement, |
| 6. To maintain good relations with personals and fellow workers. | <ol style="list-style-type: none"> Knowledge of local language Knowledge about personnel back-ground and their habits. | <ol style="list-style-type: none"> To help his fellow men. To look after their welfare | Cheerfulness, good-speech habits, courtesy, Dependability. Co-operativeness, Trustworthiness. |
| 7. To procure tools and raw material | <ol style="list-style-type: none"> Knowledge about working tools, and tool materials and their costs. Supply source of tools and raw materials and expected delivery schedules. | <ol style="list-style-type: none"> To initiate the procurement action in time. To be aware of the availability of tools raw materials and their prevailing prices. To observe effective and good relations with the suppliers | <ol style="list-style-type: none"> Discipline Courtesy Good speech habit Cheerfulness Alertness Promptness Dependability Judgement Trustworthiness. |
| 8. To maintain accounts | <ol style="list-style-type: none"> Knowledge about book-keeping Knowledge about balance sheets. Knowledge about taxation. | <ol style="list-style-type: none"> Ability of maintaining account books, and preparing of balancesheets, Consultation of account experts from time to time | <ol style="list-style-type: none"> Alertness Accuracy Promptness Efficiency |

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| 9. To communicate effectively using regional language | Working elementary knowledge of the language | <ol style="list-style-type: none"> 1. Ability to speak 2. Ability to write | <ol style="list-style-type: none"> 1. Good manners 2. Patience 3. Politeness 4. Honesty and trustworthiness 5. Clean Habits |

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| 10. - Ability to read and analyse blue print | <ul style="list-style-type: none"> - Techniques and precautions in using drawing instruments - Explaining the first and third angle projection methods - Orthographic projection of machine components | <ul style="list-style-type: none"> - Use of drawing instruments - Planning of layout of the drawing - Drawing of orthographic projections of machine components |
|--|---|--|

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| | - Conventions of common features and engineering materials as per IS 696, 1972 | - Drawing of conventions of common features of gears, gears, springs, bolts, nuts, threads and other similar machine elements and the conventions of engineering materials as per IS 696:1972 (revised) | |
| | - Pictorial views and isometric projections of simple machine components and geometrical solids. | - Drawing of pictorial views and isometric projections of various machine components and geometrical solids like prisms, cones, cylinders, spheres etc. | |
| | - Features of Screw Threads | - Drawing of profiles of different threads like B.S.W., Metric, Acme, Square threads, | |
| | - Details of assembly drawings | - Drawing the assembly drawings from the given details and showing the inner portion in sections. | |
| 11. To identify different grades of surface finish | - Regarding surface finish grading and tolerancing | - Drawing of machine components and giving dimensions indicating the tolerance and the grade of surface finish as per IS 696:1972 | |

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| 12, 13. | To select and set proper speed, feed and depth of cut | <ul style="list-style-type: none"> - Regarding job material and size - Calculations for speed, feed and depth of cut | <ul style="list-style-type: none"> - Analysing job material by observing colour, density, spark etc. Measuring of dimensions of job blank. - Making selection of speed feed and depth of cut from available tables, depending upon the material and size of job blank and tool material. |
| 14. - | Ability to perform turning operations on lathe machine | <ul style="list-style-type: none"> - Fixing/setting of job on lathe machine | <ul style="list-style-type: none"> - Parting off the material to blank size - Marking the centre on the job - Tightening of the job in lathe chuck - Starting the lathe machine and checking the concentricity of job on the machine using the surface gauge - Fitting the dead centre/revolving centre in the tail-stock - Setting the tail-stock centre on the job and positioning the tail-stock on the lathe bed. - Locking the tail-stock on the lathe bed. |

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- Adjusting the pressure on the job by rotating the tail-stock wheel.
- Locking the tail stock lead screw.
- Checking the free movement of job on lathe M/c
- Checking the cutting edge for wear
- Grinding the tool to get correct tool geometry depending upon the tool material and the metal to be cut.
- Positioning of tool in the tool-post and adjusting its height to the centre-line of job by taking the tool-tip near the dead-centre tip.
- Tightening of the tool in the tool-post while observing the correct height of the tip.
- Adjusting the inclinations of the tool-axis with the job for getting proper clearance.

- Regarding fixing of tool in the tool post

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| Speed Rations of Head stock | - selecting the speed by changing levers for all geared head stock. | |
| | ● R | |
| | selecting the speed by changing the belt position on cone pulley type head stock | |
| Feeds available on lathe machine | Engaging the feed gear box with lathe spindle in head-stock by shifting the change lever. | |
| | Setting the calculated feed on gear box by adjusting the levers on feed gear box according to the chart fixed to the lathe machine. | |
| Cross slide function | Determining the least count of the circular scale of the cross-slide lead screw. | |
| Knowledge regarding controls on the apron viz. Half-Nut operating lever, wheel for longitudinal slide, lever for automatic, | Operating the controls on apron | |

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| | Longitudinal slide, lever for automatic cross-slide and star lever for operation of clutch. | Checking and set all the control levers on apron in their proper positions so that the carriage can be moved freely on the lathe bed ways. | |
| | | Taking the carriage on the right hand side of the lathe bed to bring the tool position at the starting point of the job. | |
| | | Moving the cross-slide lead screw for the tool to come in contact with the job | |
| | | Rolling the tool back one turn and then to shift the position of tool in the gap of right end of job and dead centre and to rotate the cross slide lead screw to get the proper depth of cut. | |
| | Starting of Lathe Machine (Cutting Operation) | Switching on the mains Operating the starting lever and checking the direction of rotation of job Checking the rotation of lead screw of lathe machine. Moving the control lever for automatic longitudinal slide in the proper direction. | |

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Bringing the automatic longitudinal slide control lever back to normal position to stop the cutting operation. Moving the cross-slide lead screw in anticlock wise direction to move the tool away from the job. Taking the carriage back to starting position, resetting the position of tool for a new cut, setting the carriage in automatic longitudinal motion by moving the respective lever in automatic position. At the end of cut bringing the automatic longitudinal feed lever to normal position thereby stopping the carriage. Moving the tool away from the job. Taking back the carriage back to the starting position. Setting the tool for the next cut and repeating the operations in the sequential way till the size is obtained of the desired size and finish.

A. Steel scale and outside caliper. Use of these for measurement

The final cuts to be smaller, at higher speed and low feed to get better finish and accuracy in job dimensions

B. Vernier caliper and Micrometer, vernier constant and least count calculations Method of holding and using.

To measure the dimensions from time to time using outside caliper and steel scale in the initial cut and with micrometer and vernier caliper near the final cuts.

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- PARTING-OFF THE
JOB. THE USE OF
PARTING-OFF TOOL.
- Removal of cutting tools
 - Fixing of Parting off tool in the tool-post and adjusting the tool height up to the centre axis.
 - Setting the tool near the parting area
 - Starting of Lathe machine
 - Using the cross slide lead screw for perpendicular toolfeed supplemented with side-ways motion by using longitudinal manual feed handle.

| | | | |
|----------------------------------|---|----------------------------|--------------|
| (a) Thread cutting (External) | Regarding thread profiles pitch, lead of threads, pitch diameter, major and minor diameters. | Drawing of thread profiles | Good Turnout |
| | | | Discipline |
| | | | Clean habits |
| | | | Regularity |
| | | | Hard Working |

Regarding Turning
operations

As discussed
at Sl. No. 14

Regarding adjustment of
Thread cutting Tool

Removal of the turning
tool and fixing and adjusting
of the thread cutting tool
of the required profile
with the help of thread
adjuster

Regarding apron mechanisms

Operating of half nut lever
in conjunction with the
thread chasing dial for
engagement and disengagement
of the thread cutting operation

Regarding change gears

Selecting the proper gear train
for cutting Metric and other
Threads.

Regarding Feed Gear Box.

Setting the various levers
of the Feed Gear Box for
the required selection of
pitch (no. of threads per inch etc.

Regarding Thread cutting
operations

Adjusting of lever of head stock
for minimum spindle speed

Setting the depth of cut
on the tool by using
circular scale on cross-slide
lead-screw.

Starting the lathe machine
in proper direction

| 1 | 2 | 3 | 4 |
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| | | Setting the longitudinal thread cutting lever | |
| | | Operating the half-nut lever when a number appears in front of index line on thread causing dial. | |
| | | Disengaging the half-nut lever at the end of cut and immediately relieving the tool from the job by turning the cross-slide lead screw wheel in the anti-clockwise direction. Bringing the carriage back to starting position. Adjusting the depth of cut on the circular scale and restarting the cut. | |
| | | Repeating the thread cutting operation till the full depth of thread is achieved. | |
| | Regarding good finish | Keeping in view of finer cuts for better finish before the completion of job. | |
| 15(b) | Internal thread cutting | Regarding Fixing the job as Exercise on external thread cutting | As per Exercise on external thread cutting |

| 2 | 3 | 4 |
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| Regarding Turning as as Exercise on external thread cutting | As per Exercise on external thread cutting | |
| Regarding Drilling a hole | Removing the dead centre from the tail stock | |
| | Fixing the twist drill of desired diameter | |
| | Drilling the hole by rotating the job in the chuck and feeding the twist drill by hand moving of tail stock lead-screw, upto the required depth and remove the drill. | |
| Regarding boring the hole | Removing the turning tool and fixing the boring tool in the tool post. | |
| | Adjusting the boring tool for the free movement of the tool inside the drilled hole upto full-length | |
| | Tightening the boring tool in the tool-post. | |
| | Turning the drilled hole to desired hole diameter (minor diameter of threads). | |
| Regarding Internal Thread cutting | Removing the boring tool from tool post. | |

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| 16. To inspect the finished job | Knowledge of measuring and inspection instruments and their use | Correct method of using the measuring and inspection instruments. | 1. Accuracy 2. Systematic 3. Cleanliness 4. Judgment |
| 17. To identify the accessories provided with machine | (a) Knowledge about steady rest, movable rest, taper turning attachment, with lathe machine (b) knowledge about surface gauge. Knowledge about different types of checks and drill bits. Knowledge of dial gauge. | 1. To set the steady rest, movable rest or the taper turning attachment properly and accurately 2. To check the functioning of the above | 1. Accuracy 2. Systematic 3. Responsibility 4. Confidence |

| 1 | 2 | 3 | 4 |
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| 18. | Grinding of the tools as per the required geometry | <ol style="list-style-type: none"> 1. Ability to handle surface gauge 2. Ability to fit proper drill bit in the chuck. 3. Ability to use dial gauge to determine surface accuracy | <ol style="list-style-type: none"> 1. Accuracy 2. Systematic 3. Cleanliness 4. Confidence 5. Judgement |
| (c) | Knowledge about gas cutting torch, knowledge about pressure regulators, knowledge about manufacture of low pressure acetylene gas | <ol style="list-style-type: none"> 1. Ability to handle correctly the gas cutting torch 2. Ability to fix the respective pressure regulators on the oxygen and acetylene gas cylinders and their operation 3. Ability to adjust the flow of water to calcium carbide pan, get the proper quantity of acetylene | <ol style="list-style-type: none"> 1. Judgement 2. Confidence 3. Systematics 4. accuracy |
| 1. | Knowledge of tool geometry | 1. Grinding of tools and making angles as per the material specifications | <ol style="list-style-type: none"> 1. accuracy 2. systematic 3. Confidence 4. Judgement |
| 2. | Knowledge of tool materials and material to be cut | | |

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| 19. To identify the specific functions of lathe machine using special attachments | a) Knowledge of drilling on lathe machine | a) To set the drill bit in the tail-stock and to set the speed of the chuck according to the size of the bit and materials of the bit and the job. | 1. Accuracy 2. Carefulness 3. Confidence 4. Systematic |
| | b) Knowledge of milling on lathe machine | b) To set the milling cutters on the lathe chuck and the job on special attachment fitted at the place of tool post in the carrier | 5. Fastful 6. Alertness 7. Judgement |
| | c) Knowledge of Grinding on lathe machine | c) To set the grinder along with motor at the place of tool-post; to set the job in the lathe chuck and tailstock and setting the depth of cut on the grinding wheel in the fashion used for setting the single point tool. | |
| 20. To use the fitting shop hand-tools | Knowledge about the various handtool required in the fitting shop viz. Bench-vice, hammer, different types of files, scraper, try-square, hack-saw. | To operate correctly the various hand tools used in the fitting shop. | 1. Accuracy 2. Systematic 3. Cleanliness 4. Judgement |

| 21. To perform scrapping, cutting and chipping operations. | Knowledge about the different types of scrapers; chipping tools and hack-saw blade geometry. | To use skillfully the scraper and chapping tools and fixing of Hack-saw blade in the correct direction in the hack-saw frame. | 1. Systematic 2. Judgement 3. Systematic | | |
|--|--|---|--|--|--|
| 22. To perform filing operations | 1. Knowledge about different types of files viz. single cut double cut, smooth and rough. 2. Knowledge about various sections of files viz. round, half-round, triangular flat knife edge etc., | To operate correctly the various files according to the surface to be made (flat, round, fillet surfaces etc.) | 1. Systematic 2. Judgement | | |
| 23. To perform marking operations | 1. Knowledge about marking gauge measuring instruments and tools. 2. Knowledge about marking procedure | Skill to operate properly marking gauge and use of surface plate and V-block | 1. Accuracy 2. Judgement 3. Carefulness 4. Systematic | | |
| 24. To perform drilling operations | 1. Knowledge about different speeds, drill chucks and drill bits. 2. Knowledge about drilling operations | To operate accurately & carefully the drilling machine | - do - | | |

25. To perform inspection

Knowledge about measuring tools, inspection gauges and inspection methods.

Correct use of inside and outside calipers vernier caliper, micrometer, thread gauges, Go-No-Go gauges skill to judge proper bend formation, and thermal twist in welding. Proper judgement about spot welds.

1. Accuracy
2. Judgement
3. Carefulness
4. Systematic

26. To perform taps and dies operations

1. Knowledge about tap-set
2. Knowledge about dies and their handles
3. Knowledge about their proper operations

To operate correctly and in systematic manner the taps for threading holes and dies for external threads

1. Accuracy
2. Correctness
3. Judgement
4. Systematic
5. Confidence

| 1 | 2 | 3 | 4 |
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| 27. To prepare the edges | <ol style="list-style-type: none"> 1. Knowledge about different shapes of edges depending upon the thickness of plates. 2. Knowledge about different types of welded joints | <ol style="list-style-type: none"> 1. To fix the plate in the vice and using the proper file for making the required shape 2. To clean the surfaces chemically or mechanically where the weld is to take place. | <ol style="list-style-type: none"> 1. Systematic 2. Judgement 3. Confidence 4. Correctness |
| 28. To set the job on table | <ol style="list-style-type: none"> 1. Knowledge regarding posit-filing of edges of the plates according to the type of weld and method of weld 2. Knowledge about fixture and the-members to control twist. | <ol style="list-style-type: none"> 1. To set the edges on the table as per weld method and the type of joint 2. To connect the tie members and adjust the plates in the fixtures as per demand | <ol style="list-style-type: none"> 1. Systematic 2. Confidence 3. Accuracy 4. Correctness |
| 29. To select proper welding technique | <ol style="list-style-type: none"> 1. Knowledge about the range of the welding methods 2. Knowledge about the materials those can be welded under a welding system | <ol style="list-style-type: none"> 1. To operate gas welding low pressure and high-pressure properly and accurately. 2. To operate electric arc welding by adjusting the required current range as per the material thickness 3. To operate the spot welding machine by adjusting the timer depending upon the thickness of sheets to be welded | <ol style="list-style-type: none"> 1. Systematic 2. Commonsense 3. Accuracy 4. Promptness |

| 1 | 2 | 3 | 4 |
|---------------------------------|---|--|---|
| 30. To adjust the gas pressures | <p>1. Knowledge about the oxygen cylinder pressure and the delivery pressure</p> <p>2. Knowledge about the acetylene cylinder pressure and the delivery pressure.</p> <p>3. Knowledge about the manufacture of acetylene gas at site</p> <p>4. Knowledge to adjust the acetylene flow depending upon the size of nozzle</p> | <p>1. To operate correctly the pressure gauges on the cylinders</p> <p>2. To deliver the required amount of water to get the desired amount of acetylene gas in low-pressure welding</p> | <p>1. Systematic</p> <p>2. Accuracy</p> <p>3. Promptness</p> <p>4. Judgement</p> |
| 31. To select the proper nozzle | <p>Knowledge about the various sizes of nozzles, and correlation of these with the thickness of the plates to be welded.</p> | <p>To select proper nozzle and to fit it on to the welding torch correctly and observing its functioning by passing oxygen gas occasionally through it.</p> | <p>1. Systematic</p> <p>2. Promptness</p> <p>3. Carefulness</p> <p>4. Judgement</p> |
| 32. To adjust flame | <p>Knowledge about the character of flame and their utility in welding different materials</p> | <p>To operate the welding torch controls accurately to get correct proportions of oxygen and acetylene for the required character of flame</p> | <p>1. Systematic</p> <p>2. Carefulness</p> <p>3. Accuracy</p> <p>4. Judgement</p> |

| 1 | 2 | 3 | 4 |
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| 33. To do welding operations | <ol style="list-style-type: none">1. Knowledge about backward and forward welding technique2. Knowledge about lap, corner and butt welding3. Knowledge about gas amounts adjustments depending upon plate thickness4. Knowledge about the quality of flame as per the material to be welding5. Knowledge about the functions of flux. | <ol style="list-style-type: none">1. To operate the welding torch properly by adjusting the pressures and the amount of gas flows, by observing the correct obliquity of the nozzle with the parent metals depending upon backward or forward welding technique. | <ol style="list-style-type: none">1. Accuracy2. Judgement3. Promptness4. Carefulness |
| 34. To clean the gas weld | <ol style="list-style-type: none">1. Knowledge about the flux used and the properties of the slag formed | <ol style="list-style-type: none">1. To remove the chemically or mechanically by using a chemical or a chipping hammer respectively | <ol style="list-style-type: none">1. Systematic |
| 35. To adjust proper voltage and current for Electric arc welding | <ol style="list-style-type: none">1. Knowledge about the current ratings and the plate thicknesses2. Knowledge about the welding transformer and the available voltage and current ranges. | <ol style="list-style-type: none">1. To adjust the required current and voltage range on the welding transformer. | <ol style="list-style-type: none">1. Systematic2. Carefulness |

| 1 | 2 | 3 | 4 |
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| 36. To select the proper electrode | Knowledge about the various types of electrodes | To select appropriate welding rod depending upon the plate thickness and the material of the plate | Judgement |
| 37. | <ol style="list-style-type: none"> 1. Knowledge about the starting of arc 2. Knowledge about the maintenance of arc 3. Knowledge about the bead formation | <ol style="list-style-type: none"> 1. Skill of starting the arc and maintaining the same by observing the gap and speed of electrode 2. Skill of forming the bead by giving proper movement to the electrode | <ol style="list-style-type: none"> 1. Systematic 2. Carefulness 3. Correctness 4. Judgement |
| 38. | To inspect the weld | <ol style="list-style-type: none"> 1. Knowledge about bead shapes 2. Knowledge about the twisting of job due to thermal stresses | <ol style="list-style-type: none"> 1. Accuracy 2. Carefulness 3. Judgement |
| 39. | To adjust the current and Timer for Electric Resistance welding | <ol style="list-style-type: none"> 1. Knowledge about the working of Electric Resistance welding M/C 2. Knowledge about the size of the tips and shape 3. Knowledge about the rate of water flow for cooling of Electrodes | <ol style="list-style-type: none"> 1. Accuracy 2. Correctness 3. Judgement 4. Promptness 5. Carefulness |

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4. Knowledge about the
sequence of weld-time
and its adjustment
on timer.

Examination Scheme and Teaching Scheme

A. For class XI

| Sl.No. | Examination Scheme | Theory paper | T.W. or Sessional | Practical | Duration of paper | Duration of practical | Teaching Scheme per week of 45 minutes each | |
|--------|---------------------------------|--------------|-------------------|-----------|-------------------|-----------------------|---|-----------|
| | | | | | | | Lecture | Practical |
| 1. | Mechanical Technology Paper I | 50 | 75 | 75 | 2 hrs. | 4 hrs. | 2 | 6 |
| 2. | Mechanical Technology Paper II | 50 | 75 | 75 | 2 hrs. | 4 hrs. | 2 | 6 |
| 3. | Mechanical Technology Paper III | 50 | 75 | 75 | 2 hrs. | 4 hrs. | 2 | 3 |

B. For class XII

| | | | | | | | | |
|----|--------------------------------|----|----|----|--------|--------|---|---|
| 4. | Mechanical Technology Paper IV | 50 | 75 | 75 | 2 hrs. | 4 hrs. | 2 | 6 |
| 5. | Mechanical Technology Paper V | 50 | 75 | 75 | 2 hrs. | 4 hrs. | 2 | 6 |
| 6. | Mechanical Technology Paper VI | 50 | 75 | 75 | 2 hrs. | 4 hrs. | 2 | 3 |

Vocational Course in Mechanical Technology

General Objectives

The student should be able to acquire skills and competencies in the operation of simple machine tool like lathe, shaper, tool grinder and in fitting and welding so that he is able to either set up his own workshop/and be self employed or get a wage employment.

Specific Instructional Objectives

- (i) should be able to recognise the parts of the lathe machine and know its functions.
- (ii) should be able to make simple jobs with accuracy
- (iii) should be able to make tapers, screw threads (L.H. & R.H.) drill hole, bore, groove, step turning.
- (iv) should be able to use three jaw chuck, four jaw chuck, a catch plate or face plate and collets and steadies.
- (v) should be able to use the lathe machine cross slide accurately and know the least count
- (vi) should be able to know the different speeds and feeds available on the machine and how to select the proper speed and feed depending upon the size and material of the job and material of the tool.
- (vii) should know about the 'change gears' wheels systems in order to obtain a variety of speeds for the 'lead screw', which will enable to have different feeds and screw pitches.

- (viii) should know about the use of dead centre and revolving centre.
- (ix) should be able to use the measuring instruments like micrometer, vernier calliper
- (x) should know about the cutting tool geometry, tool materials, tool holders, tool posts and types of single point tools available to work on lathe machine.
- (xi) should know about the knurling operation
- (xii) should know about truing job.
- (xiii) should know about the parts of the shaping machine and its functions.
- (xiv) should know about the reciprocating motion of the tool and stroke length and its setting
- (xv) should know about drills and drilling machine.
- (xvi) should know how to mark exact positions where the holes have to be drilled
- (xvii) should also know the use of reamers to get accuracy in diameter of drilled holes. This is a finishing operation.

- (xviii) should know about drill chucks.
- (xix) should know about the grinding of drills
- (xx) should know about hand tools like spanners, files, pliers, hammers, chisels, screw drivers, scrapers, surface plate, hacksaw, hand shears, vice etc.
- (xxi) should know the use of feelers gauge and make assemblies with its use
- (xxii) should be able to assemble bearings and also disassemble them when needed.
- (xxiii) should be able to secure gearwheel to the shaft with the help of keys.
- (xxiv) should be able to do oxy-acetylene welding
- (xxv) should know about various electric arcs
- (xxvi) should be able to prepare the edges for different types of joints.
- (xxvii) should be able to weld cast iron
- (xxviii) should be able to do electric arc welding
- (xxix) should be able to understand the engineering drawing i.e. blue print of the detail and should be able to read the various dimension from the blue print.
- (xxx) should be able to understand the orthographic projections, system of dimensioning and system of showing tolerances on parts.

- (xxxI) should be able to understand the system of limits and fits as per Indian standards
- (xxxii) should know about various engineering materials in use.
- (xxxiii) should be able to make springs and coils on lathe machines
- (xxxiv) should be able to make components from sheet metal by spinning
- (xxxv) should be able to prepare drawing from given components.
- (xxxvi) should be able to visualise object from given orthographic projections.

MECHANICAL TECHNOLOGY

PAPER - I

LATHE MACHINE

Classification

Specifications

Names of various parts and sub-assemblies of centre Lathe, and their functions.

Difference between general purpose lathe machine and special purpose lathe machine.

Accessories of S.S. and S.C. Lathe machine, viz, Lathe centres, face plate, Angle plate, Three jaw chuck, four jaw chuck, collet, mandrels, steady rest, moving rest, Taper turning attachment. Description of the above accessories giving their sketches and elaborating their uses

Lathe Tools: Their classification, tool material viz. High carbon steel, High speed steel, carbide tipped tools.

Speed, feed and depth of cut. Their selection

Geometry of single point cutting tool, various angles and their values for cutting different metals.

Special purpose tools, viz. facing tool, Parting-off-tool, external thread cutting tool, knurling tool, boring tool.

Lathe Operations: Surfacing, sliding, and screw cutting.

Manual as well as automatic operations.

Facing, ; plain turning, Taper turning, external thread cutting and chamfering.

Calculations for cutting external threads viz. metric threads and B.S.W. threads.

PRACTICALS

Exercises based on Syllabus mentioned above., list of blue prints attached, at the end of this book to serve as samples.

MECHANICAL TECHNOLOGY

PAPER - II

ENGINEERING MATERIALS:

Physical properties of metals.

hardness, toughness, strength, Brittleness, elasticity,
malleability, ductility.

Ferrous Alloys:

Cast Irons: composition, properties and uses of Grey cast
Iron and S.G. Iron, Effects of alloying elements on the
properties of cast Iron.

Wrought Iron. composition, Properties and uses.

Alloy steels: Alloying elements for steel and their
effects on its properties.

Special alloy steels viz. chromium steel, Nickel steel,
Stainless steel, manganese steel, Molybdenum steel
Tungsten steel vanadium steel, High speed steel, Their
composition, properties and uses.

Designation of cast iron and steels according to Indian
standard

Equivalent Indian standards for various foreign standards
regarding different engineering materials.

Non-Ferrous Alloys.

Aluminum and its alloys viz. Aluminium copper alloys, Duraluminium. Their composition, properties and uses.

Brasses: Their composition, properties and uses.

Bronzes: Their composition, properties and uses.

Elementary treatment of non-metallic materials of construction.

Simple heat treatment methods viz., Annealing, Normalising, Case hardening and Tempering.

FITTINGS

Hand tools, hammers, pliers, spanners wrenches, punches, Files, taps and dies, screw drivers, hacksaw, try-square. Their description and uses.

Measuring tools-outside caliper, inside caliper, odd-leg caliper, combination set, Their description and uses.

Marking tools: V-block, surface plate, scriber, steel scale, marking gauge, Their description and uses.

Drilling machine-bench type, its description and working.

Grinding machine, Bench type, its description and working

PRACTICALS

Exercises based on the syllabus mentioned above.

List of Exercises attached at the end of this book to serve as samples.

Mechanical Technology

Paper - III

(Engineering Drawing)

Drawing instruments and their uses .

Layout of drawing sheets-Drawing sheets and their sizes - Information on drawing sheets-Part list in case of sub assemblies -Folding of prints.

Scales: Ordinary scale, vernier scale, and diagonal scale-Representation of scales and representation of different scales on the same sheet.

Lines and letterings according of Indian Standard IS 696 - 1972.

Orthographic projections: 1st and 3rd angle projection-

Drawing of a third view from two views of a machine component- Sketching orthographic views from pictorial views as well as orthographic projection of simple machine elements and vice versa Reading and interpretation of blueprints of simple machine components.

Screw thread : Definitions of various elements of a thread-pitch and lead-right hand and left hand threads. Multi start threads - Various forms of screw threads viz. Metric threads, B.S.W. threads, B.A. threads, pipe threads-

Square threads - Acme threads- Trapezoidal threads-

Buttress threads - And Knuckle threads.

Turn buckle :

PRACTICALS

Drawing sheets based on the syllabus
mentioned above.

One Drawing Sheet on each topic.

MECHANICAL TECHNOLOGY

PAPER - IV

Limits, fits, and tolerances

Need for limit systems. Types of fits viz. clearance fits, transition fits, interference-fits, elaborating the above with example, Limit gauges and their application to limits and tolerances and correlation of allowance with the type of fit.

FITTING

Measuring instruments: Vernier caliper, Micrometer their description and uses.

Gauges: Depth gauge, standard wire gauge, feeler gauge, screw thread gauge.

Twist Drill and Reamer : Geometry of cutting edges of the twist drill and its construction. Use of reamers as finishing tools.

Power Hacksaw: Description and working.

Torque wrench: Construction and its use.

Grinding machine : Bench type, its description and working.

Welding

Classification of welding methods.

Principle of oxy-acetylene gas welding, low pressure and high pressure gas welding method. Different types of flames and their Uses.

Flux, its composition and functions:

Electric Arc Welding, its principle, edge preparation and its importance. Types of welded joints, equipment required for metal electrode arc welding method using
(i) A.C. supply (ii) D.C. supply

Flux coated electrodes and their composition for welding different alloy steels.

Electric Resistance welding: Its principle, Control of current and resistance in the circuit. Description and working of spot welding machine.

Exercises based on the syllabus mentioned above.

List of Experiments.

Welding

A. GAS welding

Learning to form bead.

Making of a Lap joint of sheet metal

Making of a small box of sheet metal.

Brazing of a cast iron job using gas welding torch

B. Electric Arc Welding

Learning to form bead on 6 mm. thick plates.

Making of a lap joint

Making of a Butt joint

Making of a T-joint

Learning of welding in vertical direction

(Material for Arc. Welding

Exercise 6 mm thick ms. plates.)

Fitting exercise

Blue prints attached at the end of this book to serve as samples

MECHANICAL TECHNOLOGY

PAPER - V

ENGINE CENTRE LATHE MACHINE.

Special operations viz. drilling, boring and internal thread cutting, calculations regarding internal thread cutting. Taper turnings using off-set method.

Use of four jaw chuck.

Knowledge about Morse tapers

Erection of lathe machine.

Care and maintenance of lathe machine

Safety rules of the work-shop

Shaping machine

Working principle. Essential features viz. Head slide, Ram, Swivel plate, clapper box, Table.

Mechanism to control stroke length, starting of stroke, Automatic feed mechanism. To elaborate these using neat sketches.

Care and Maintenance of 1) Lathe 2) Shaper 3) Tool Grinder 4) Bench Drill.

Erection of 1) Lathe 2) Shaper 3) Tool Grinder 4) Bench Drill

Safety consideration in a workshop

Elementary treatment pertaining to
entrepreneurship.

PRACTICALS

EXERCISES BASED ON THE SYLLABUS MENTIONED ABOVE

A SET OF EXERCISES ATTACHED. (BLUE PRINTS) AT

THE END OF THIS BOOK TO SERVE AS SAMPLES.

(Engineering Drawing)

Isometric Projections: Drawing of isometric scale-d
distinction between (a) isometric drawing and
isometric projection.

(b) isometric lines and non isometric lines-Preparing
drawing of a rectangle, hexagon, pentagon, circle
and arc, procedure for preparing isometric sketching
of simple block involving circle, arc and angles -
Isometric sketching of simple machine components.
pictorial views.

Details of the following mechanical elements:-

Knuckle Joint

Cotter Joint

Journal bearings-plummer block-

Bracket bearings.

Pulleys

Assembly of the above units and their sectional
views viz. front view, Top view and side view.

Keys in their assembled view like sunk key, feather
key, woodruff key, spline keys.

Nomenclature of geometry of spur gears.

Conventional representation of common features and materials as per I.S. 696-1972

Dimensioning and Tolerancing.

PRACTICALS

Exercises based on the syllabus mentioned above-

(at least four exercises out of which one should be from each chapter mentioned above.)

List of Equipments.

1. Set of openended spanners.
2. Set of ring spanners
3. Set of Box spanners
4. Set of Allen keys
5. Set of gears
6. Grinding attachment
7. Milling attachment
8. Taper Turning attachment
9. Lathe machines rests
10. Lathe chucks
11. Twist drills
12. Center Drills
13. Bench Drill machine
14. Drill chucks
15. Bench-vice
16. Working table
17. Surface plate
18. Surface gauge
19. Scriber
20. Scraper
21. Chipping tool
22. Differant size Hammers
23. A set of files

24. Set of taps with handle
25. Set of dies with handle
26. Hack-saw blades and Hack - saw frame.
27. Measuring scale and Tools (Inside and outside caliper)
28. Measuring Instruments (Vernier caliper, micrometer)
29. Dial gauge
30. Electric Arc welding set complete with leads, electrode holder and screen
31. Oxy-acetylene gas welding set complete with welding torch, nozzles, lighter and goggles.
32. Pressure gauges for oxygen and acetylene gas cylinders.
33. Working Tables, one each for gas welding and electric arc welding
34. Welding rods and welding fluxes.

JOB No. 1

MAT. M.S. BAR
 $\phi 40 \text{ mm}$

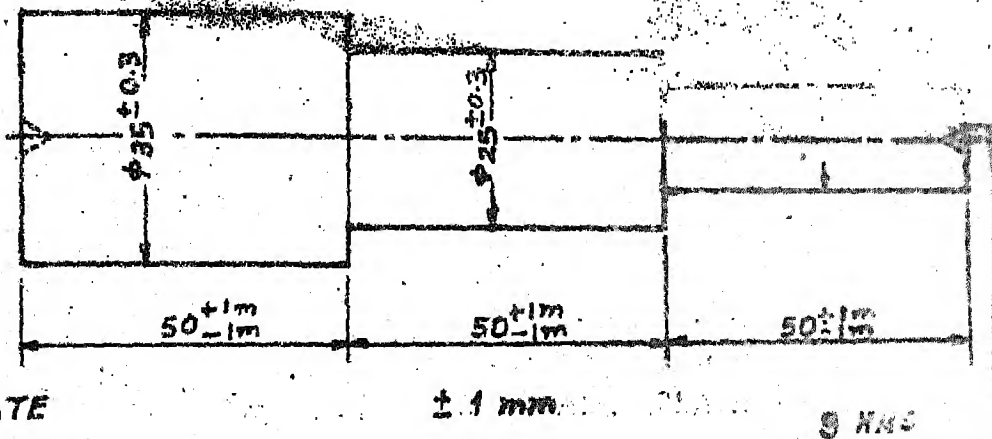
STOCK LENGTH
155 mm

USE

FACE PLATE

JOB Ex. 1

WITH FACE PLATE



Job No. 2

MAT. M.S. BAR $\phi 40 \text{ mm}$

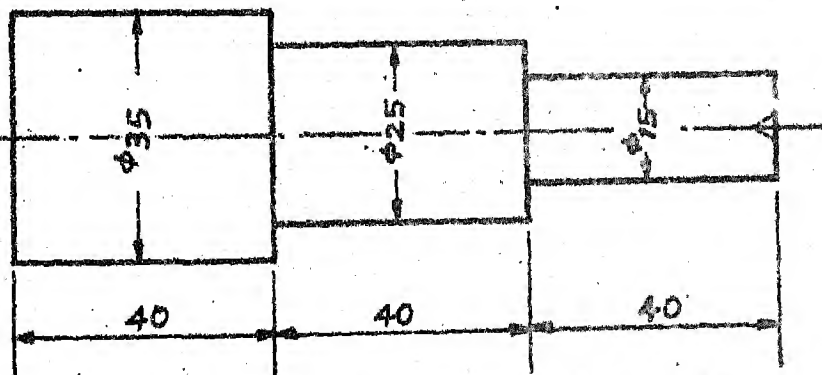
STOCK LENGTH 155

USE THREE JAW CHUCK

MEASURING TOOL

OUTSIDE CALIPER

STEEL SCALE



JOB Ex. 2 WITH THREE JAW CHUCK

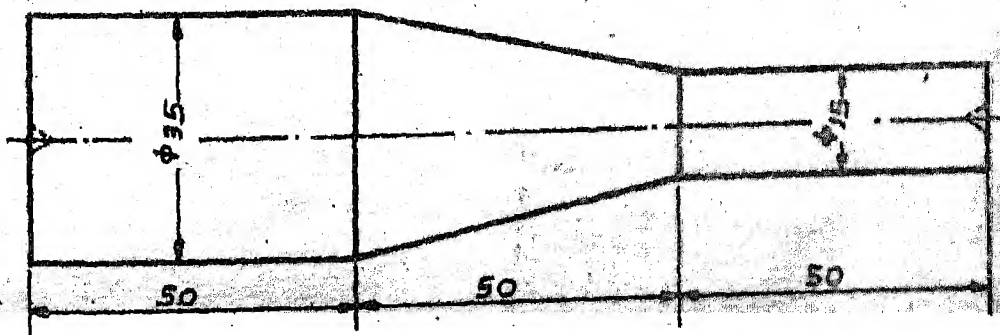
9 HRS.

STOCK M.S. BAR $155 \times \phi 40$

JOB Ex. 3

FACE PLATE

TIME 15 HRS



EXERCISE ON TURNING.

(11)

STOCK SIZE 155 × $\phi 40$

JOB Ex. 4

ACCURACY

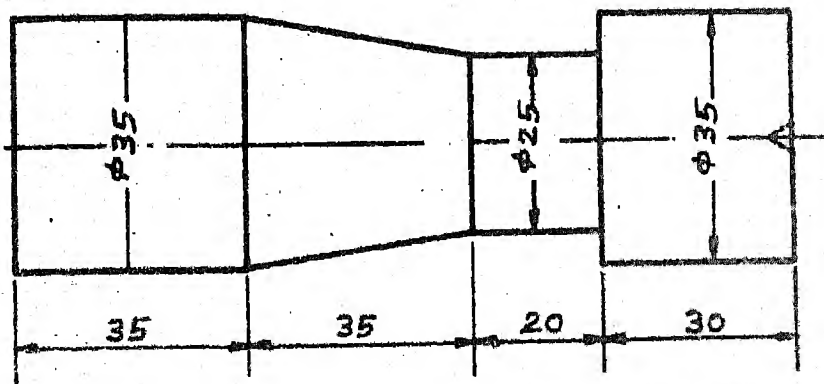
LENGTHS $\pm 0.5\text{mm}$

DIAMETER $\pm 0.1\text{mm}$

MEASURING TOOL

VERNIER CALIPER

MICROMETER



TIME 20 HRS

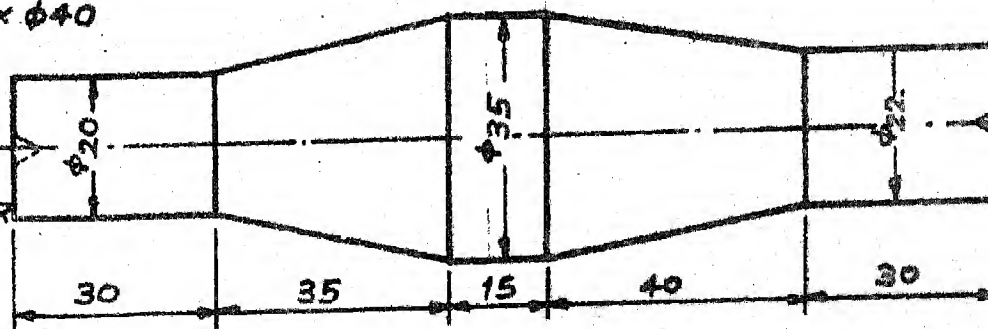
STOCK 155 mm × $\phi 40$

ACCURACY LENGTH
 $\pm 0.5\text{mm}$

ACCURACY DIAMETER
 $\pm 0.1\text{mm}$

JOB No. 5

WITH FACE PLATE



TIME 15 HRS

STOCK 155 mm × $\phi 40$

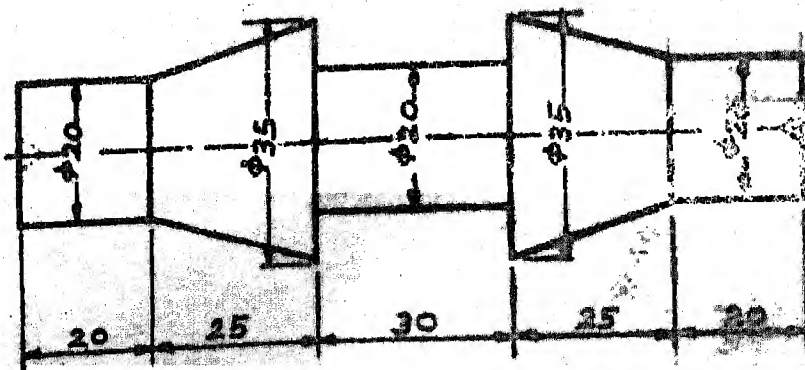
JOB No. 6

THREE JAW CHUCK

MEASURING TOOL

VERNIER CALIPER

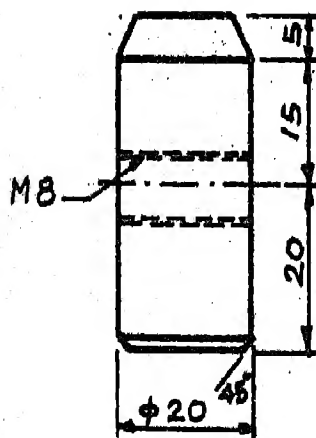
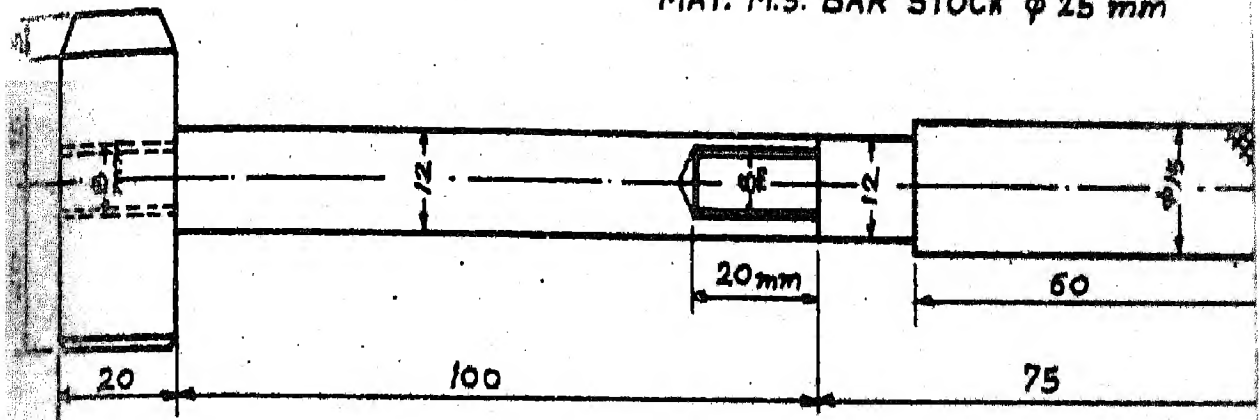
MICROMETER



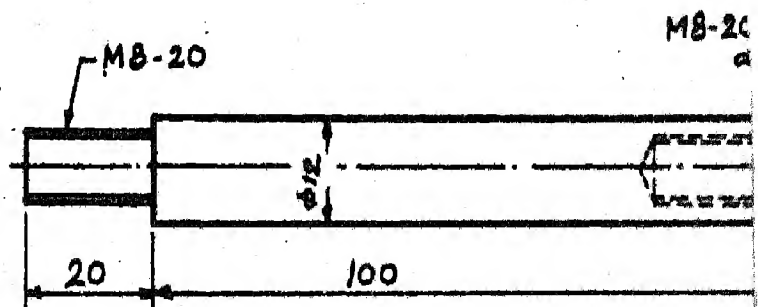
TIME 15 HRS.

EXERCISE ON TURNING

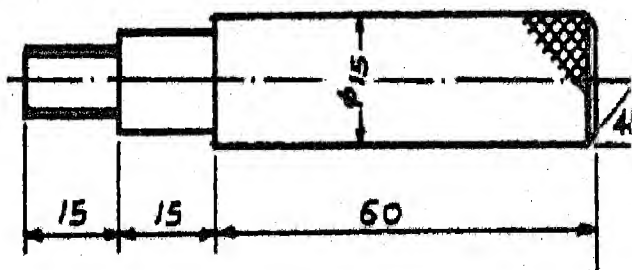
MAT. M.S. BAR STOCK $\phi 25 \text{ mm}$



1

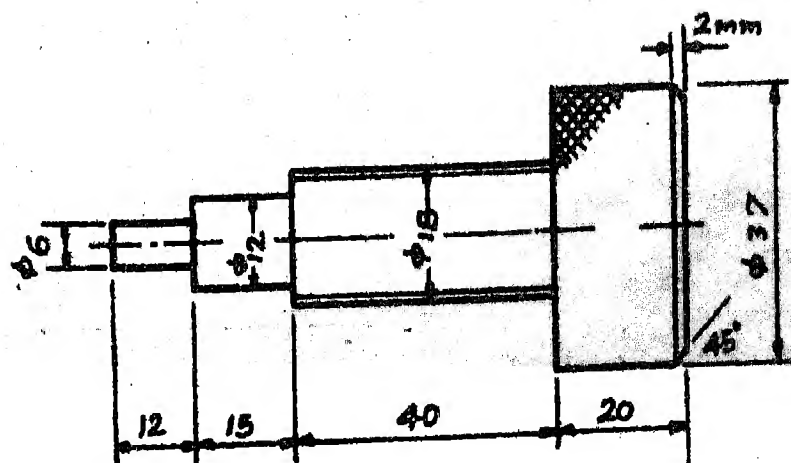
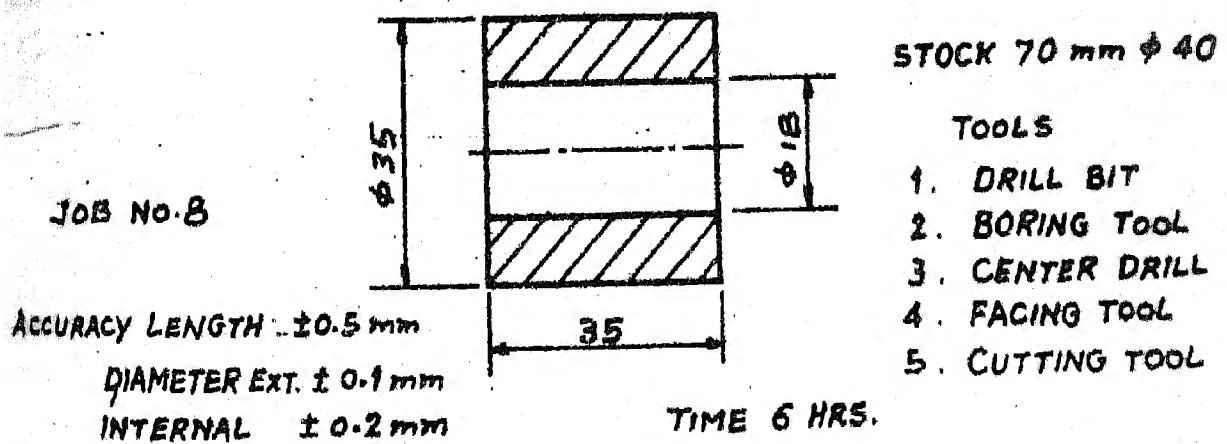
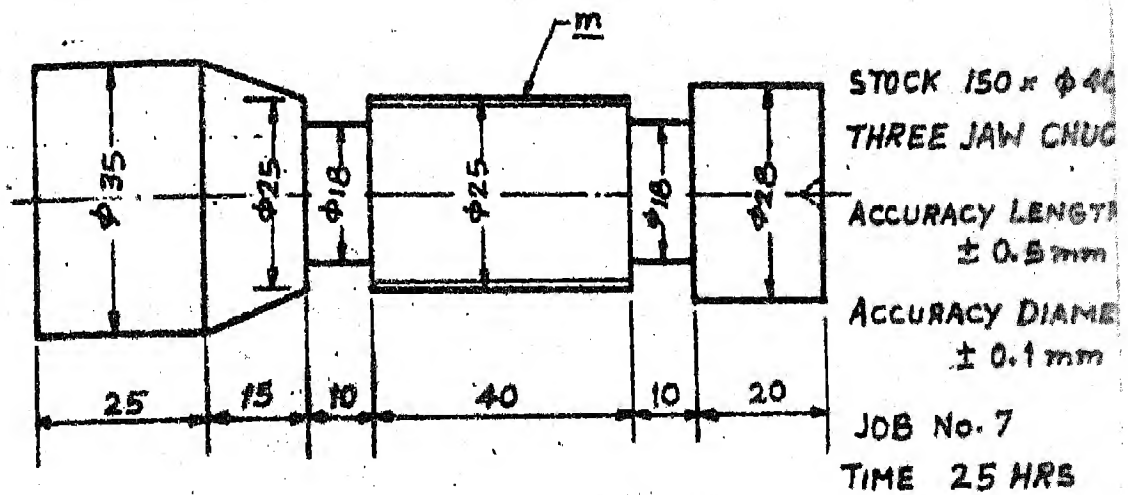


2



3

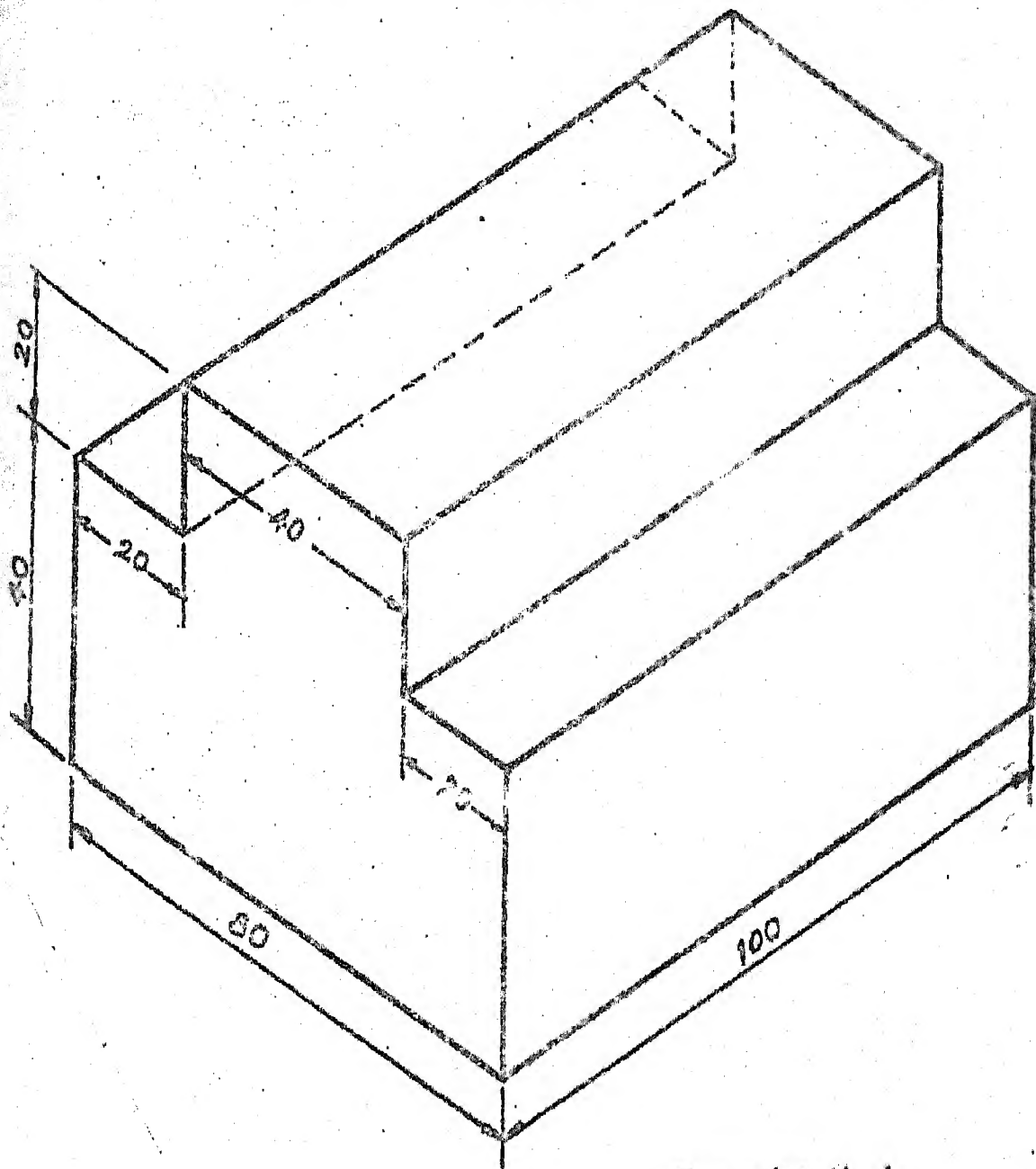
EXERCISE ON TURNING



(V)

(V)

Exercises on Shaping Machine

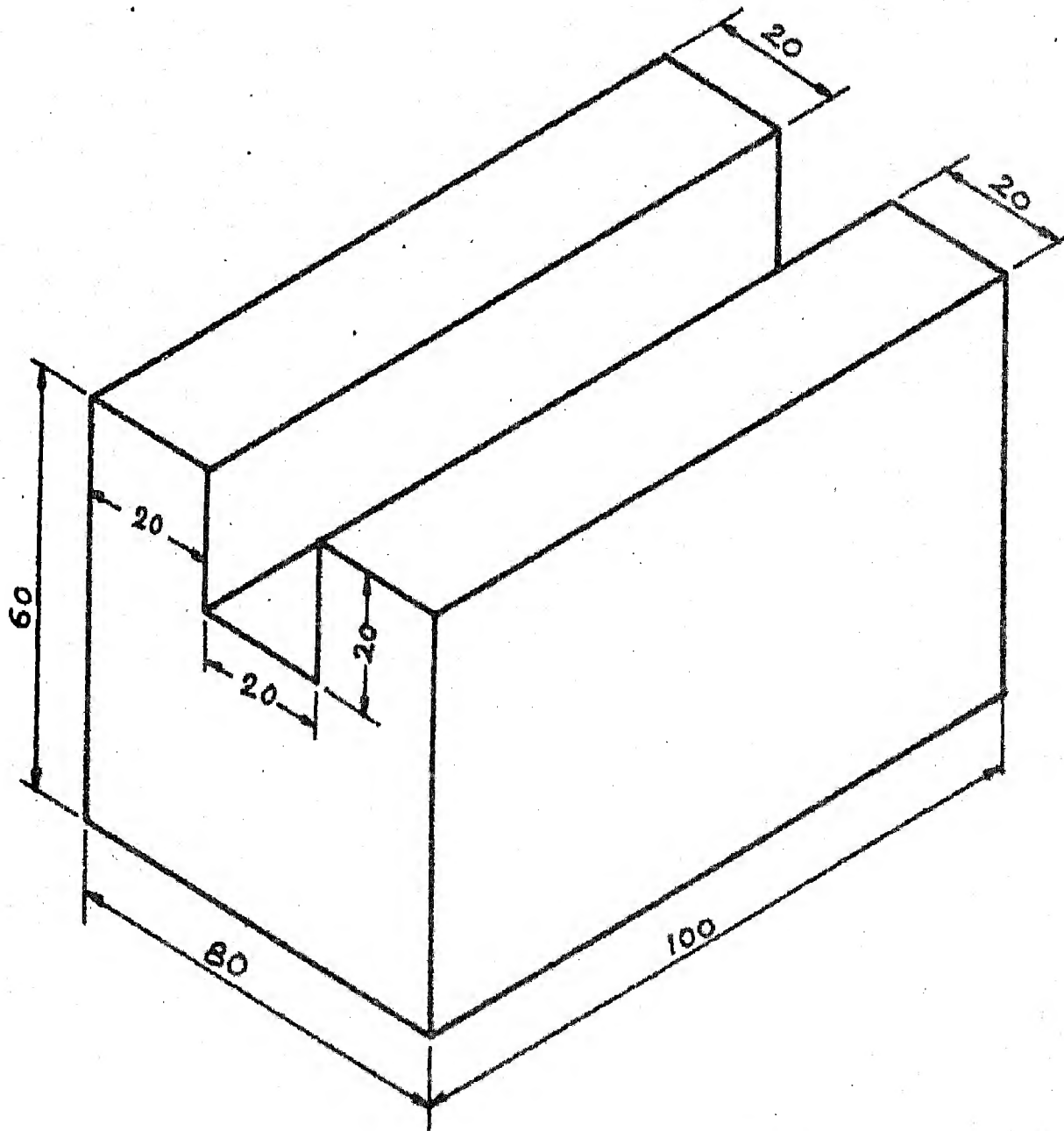


Exercise No-1

TIME 10 HRS.

(VI)

(vii)



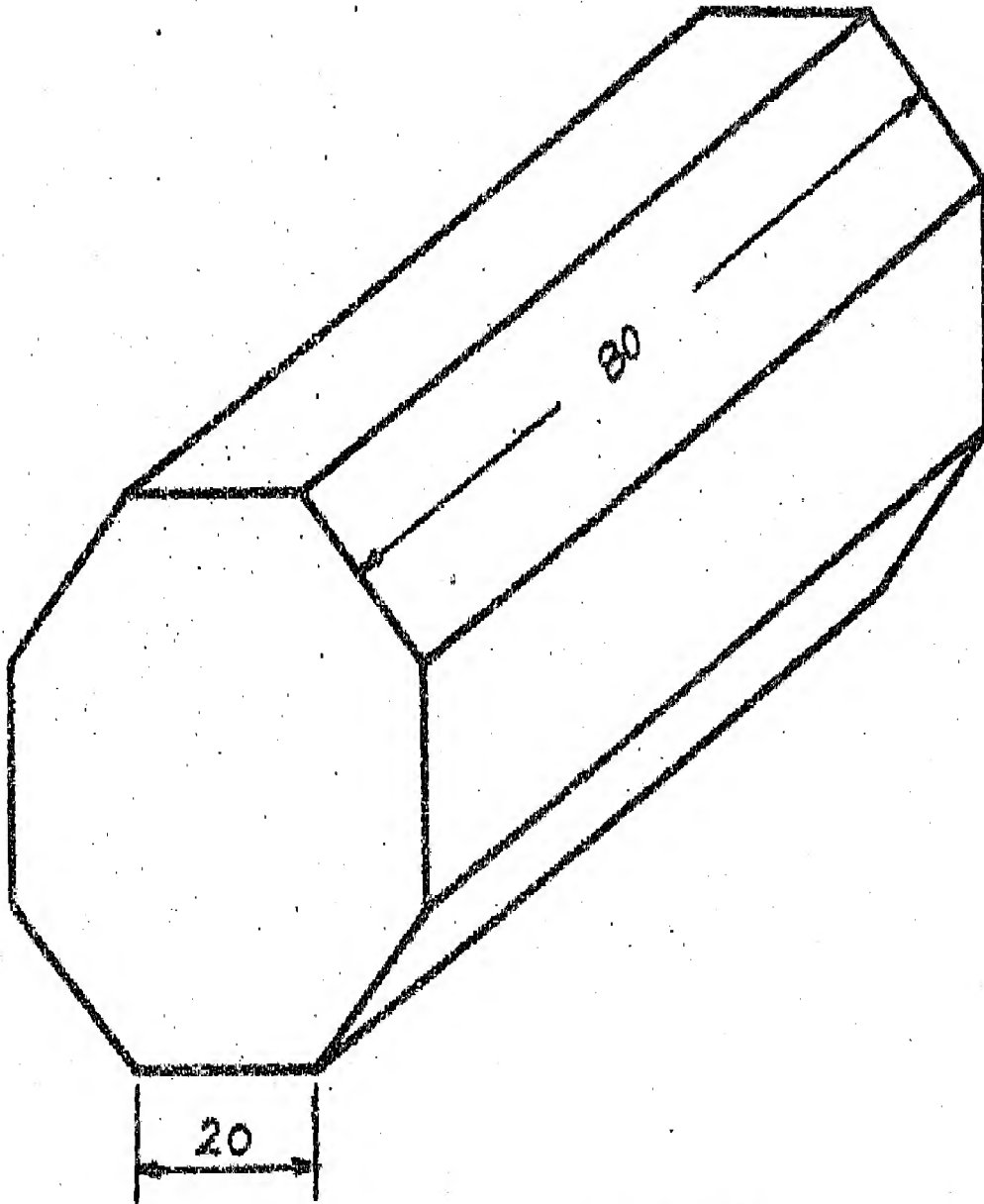
Job No.2

TIME 15 HRS. .

EXERCISE ON SHAPING MACHINE

(VII)

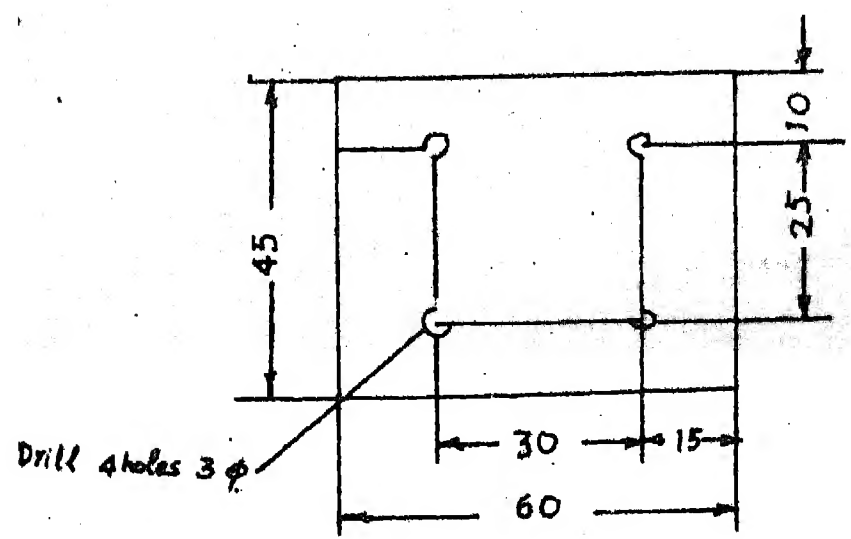
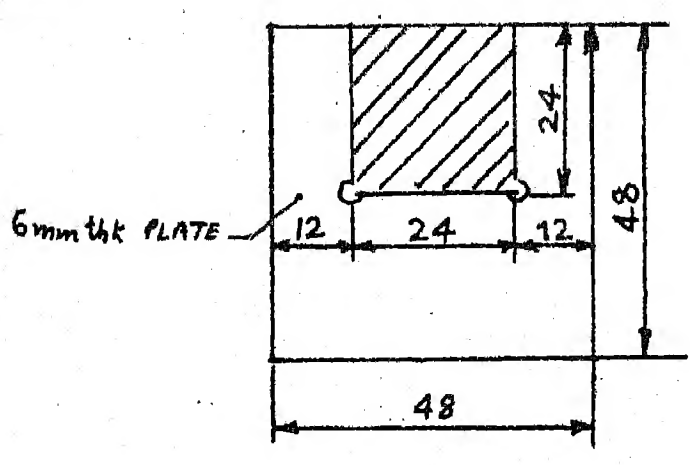
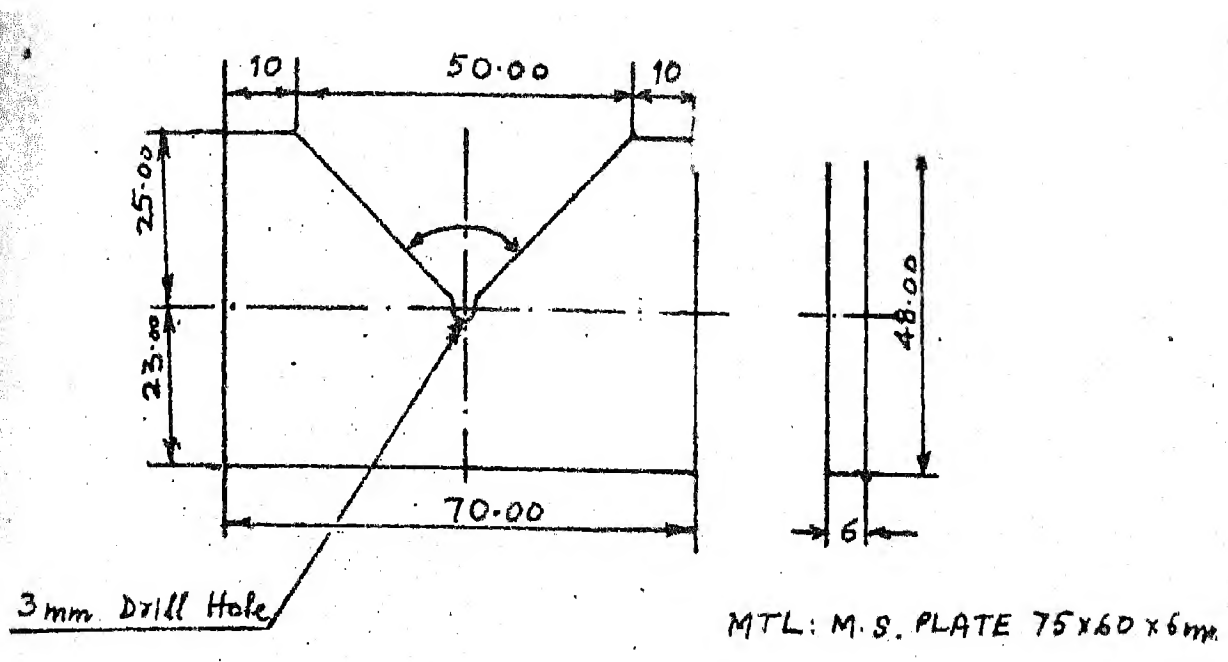
(VII)



Job No. 3

TIME 20 HRS

EXERCISE ON SHAPING MACHINE

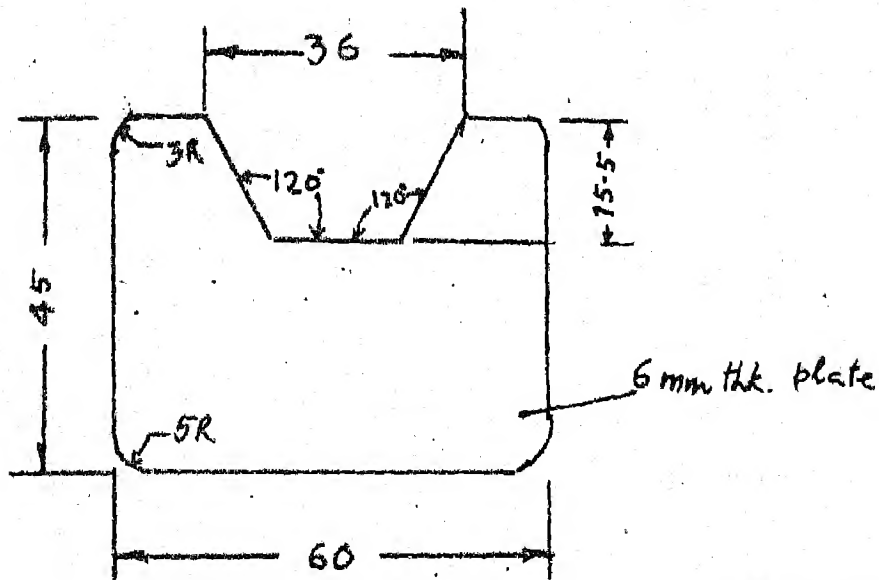


Mtl: M.S. Plate

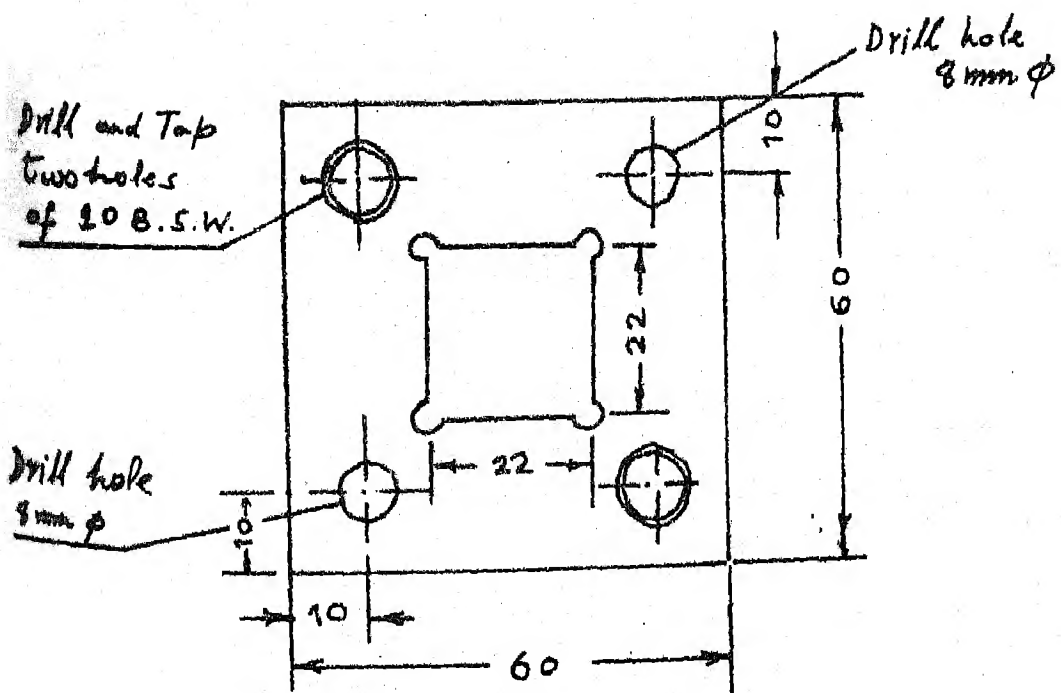
EXERCISES IN FITTING.

(1X)

(11)

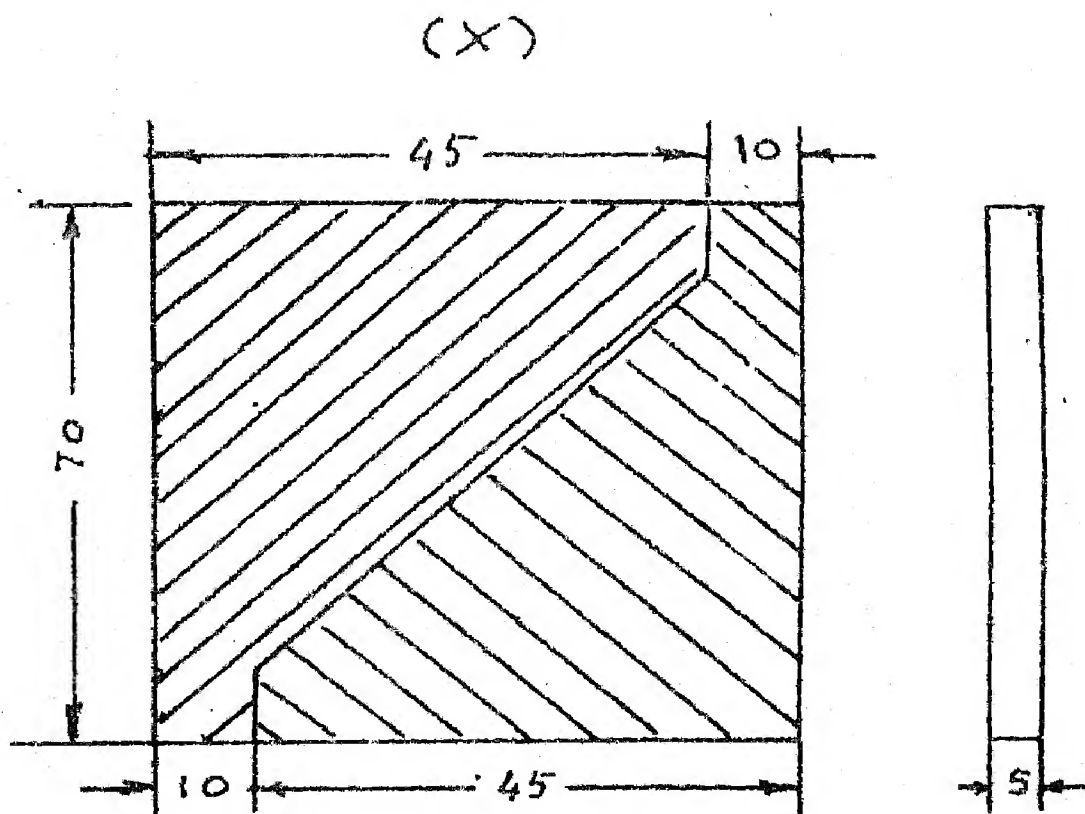


Mtl: M.S. Plate

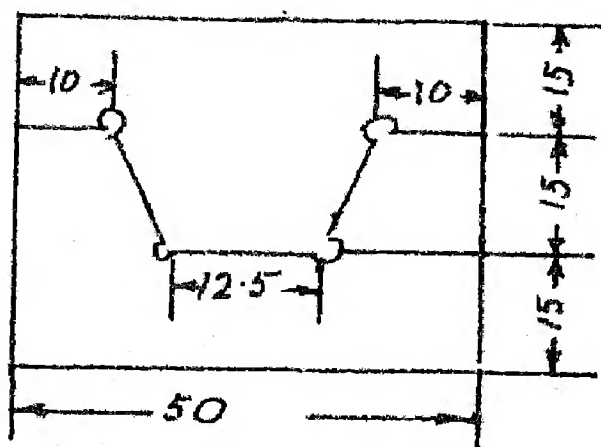


Mtl: M.S. Plate 9.5 mm thk.

Exercises in Fitting



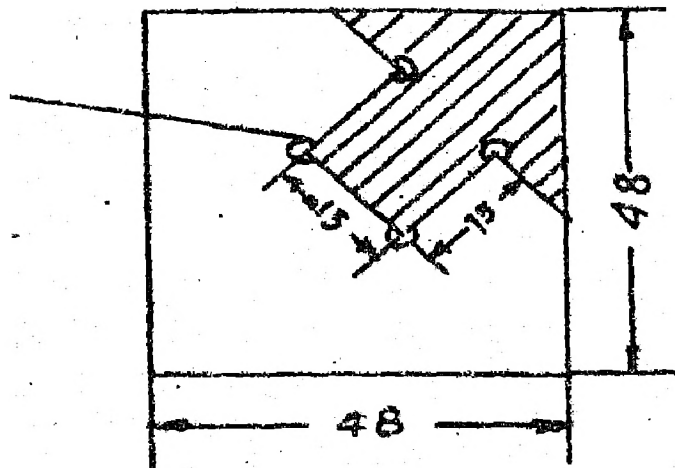
MTL M.S. PLATE $50 \times 75 \times 6 \text{ mm}$ TWO PIECES.



MTL. $50 \times 50 \times 6 \text{ mm}$.

EXERCISES IN FITTING.

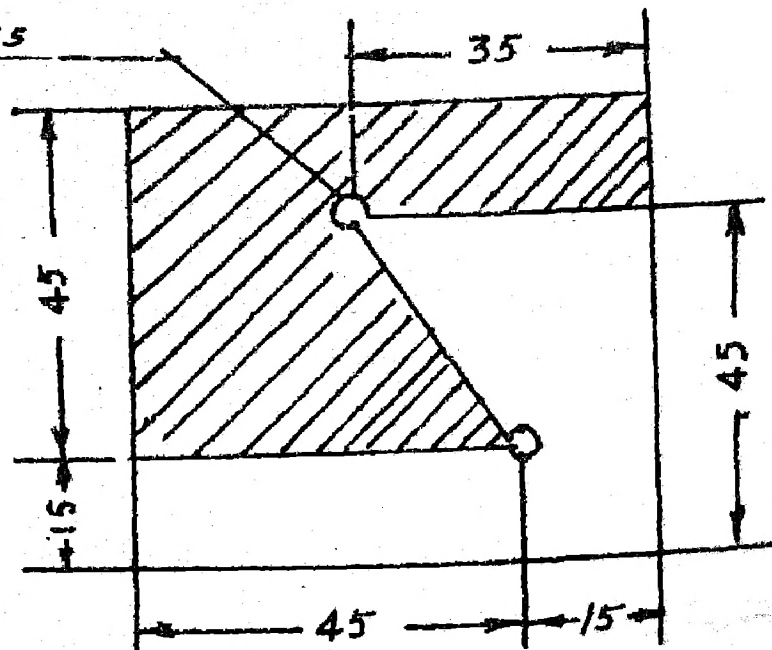
(X1)



M. S. FLAT 50 x 50 x 6 mm THK. ONE PC.

M. S. FLAT 38 x 38 x 6 mm THK ONE PC.

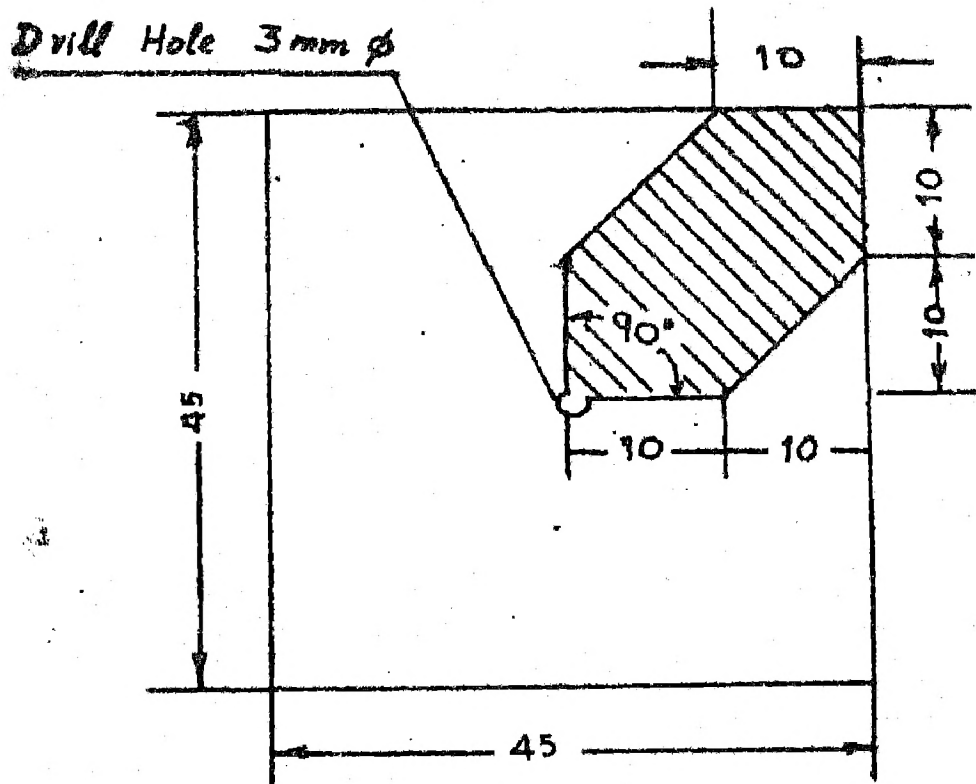
DRILL 3 ϕ TWO HOLES



MTL. M. S. PLATE 50 x 65 x 6 mm

NO. REQD. TWO OFF

EXERCISES IN FITTING



- MTL
- (i) $50 \times 50 \times 6\text{ mm}$ blk
 - (ii) $25 \times 25 \times 6\text{ mm}$ blk

ALL DIMENSIONS IN MM.

EXERCISE IN FITTING.